in our experiment stations over the important applications of chemistry to agriculture.

The third and most important function of the laboratory is the contribution which it makes to the growth of our science. Here in Oklahoma you have many problems which can be solved with the aid of chemistry. But just as Germany would have failed utterly to reach her highest achievements if her university professors had confined themselves to so-called practical problems, so this or any other university will fail if its staff does not devote a considerable part of its energies to the advancement of the science of chemistry quite irrespective of whether industrial applications for the results of their researches are apparent or not. No chemical laboratory has a right to call itself a university laboratory if it loses sight of this, the highest of its functions. A high-school may devote itself exclusively to teaching and a college may possibly do the same, though of that there is serious question. For the university there can be no question. Ours is a vital, growing, rapidly changing science and only those who are intensely interested in its growth can properly teach and inspire those who are to go out into the world and use for the advantage of themselves and of the state the training they gain in university halls.

William A. Noyes

MILITARY GEOLOGY

Modern warfare is a science, or rather an application of many sciences, and therefore it can afford to neglect no scientific field the cultivation of which would make for added superiority, in however slight degree. The usefulness of certain sciences to the carrying on of war is obvious or has been made so by the conditions of the European contest: such are surgery and chemistry; the military application of certain other sciences, however, is not so apparent and needs to be pointed out from within the subject itself: thus it is with geology. If the service that this science can render to the country in time of war be clearly established, then it follows that geology will be incorporated in our plan of military development and be called upon to do its proper part in furthering the military effectiveness of the nation.

This is a new rôle for geology, but a rôle already played and established in the theater of war in Europe. Military geology is a phase of applied science that has served the warring nations abroad; it sees many duties that it may perform for the United States.

In the first place, geological knowledge may be employed to advantage by an army in the field. "What a Geologist Can Do in War," is the title of a brochure prepared by R. A. F. Penrose, Jr., for the geological committee of the National Research Council and published in April, 1917. This short essay in scarcely more than a thousand words specifies clearly the varied service that a knowledge of geology can render, not only to the army in camp, but to the army on the march and in battle. The importance of this service may be judged by observing some of the problems arising in the course of field operations, which the geologist might appropriately be expected to solve.

The selection of camp-sites involves problems in drainage and sanitary arrangements, which become more difficult of solution in marshy country; in arid regions the possibility of disastrous cloudbursts destroying camps improperly located demands attention. Trenches and tunnels must be placed, so far as strategic conditions allow, in easily workable and drainable rock formations; while the stability of slopes depends upon the material in which the excavations are made. Ground for artillery positions should be selected not only from topographic considerations, but also in respect to the firmness and elasticity of the underlying rock, upon which the accuracy of fire will in part depend. The construction or repair of roads is a frequent military need, the more important because of the nec-

essity for transporting heavy artillery, for which the ordinary road-bed is inadequate.

Topographic maps carry a special meaning for the trained geologist while geological maps yield information of value in regard to the strategic quality of the country of advance; even without maps the geologist can draw inferences as to the ease and safety with which the country ahead may be traversed. The vibration effects of prolonged artillery fire in mountainous regions are likely to cause landslides and snowslides, which may prove disastrous if not anticipated and guarded against; but vibrations arising from the enemy's fire may be turned to advantage through seismographic records, showing the point of origin. Lastly, the question of an adequate water-supply is ever present, and the ordinary sources may often be enlarged or improved upon by the location of underground or artesian waters, while in deserts the avoidance or chemical improvement of waters too strongly alkaline becomes frequently of paramount importance.

In these respects, then, an army without geological knowledge is at a disadvantage; for the problems mentioned are all within the capabilities of the geological engineer and some of them must remain unsolved if geological advice is not at hand.

In the second place, an army employing geologists in its field activities can facilitate their effectiveness by maintaining a geological department at home for the accumulation of geological data and in particular of geological maps covering all possible regions of military activity. It is no small task to assemble such material in form and quantity suitable for use on short notice in any part of the world. Such a department, therefore, should be established in advance of field operations. A new type of map recently employed by physiographers, which shows by a block diagram both the topographic features and the underlying rock structures, would without question prove of distinct advantage to commanding officers planning a campaign or executing field manoeuvers. Few maps of this kind have ever been constructed; their preparation is slow and requires considerable skill and knowledge. It would fall within the province of the home office to develop the usefulness of this sort of map. The department also would appropriately assemble information on the water resources of regions of prospective occupation, so that the geologist in the field might be supplied with such results of previous geologic work, particularly in the enemy's country, as would facilitate his search for sources of water-supply.

A third way in which geology can contribute to the military strength of a country is through a study from a military standpoint of its mineral resources, the raw materials of war. In the United States, our mineral resources have long been the subject of organized investigation on the part of the Geological Survey, which has accumulated detailed and accurate information regarding them of the highest value at the present time. But the investigations of the Geological Survey have naturally been confined largely to the economic and scientific aspects of its field, and while much of its information can be quickly interpreted in terms of military necessity, the fact remains that this accumulated knowledge, much of it of the deepest military significance, has remained largely unused by military authorities, and the United States to-day is unprepared in respect to a few mineral products essential to war, such as nitrogen, potash, manganese, nickel, tin, and platinum. This country as a whole, however, is at a relatively efficient stage of preparedness in regard to her mineral industry, not because the government has studied and anticipated her military needs in this respect, but because recent economic demands have in most particulars been analogous to impending war demands, and hence the mineral industry under present economic conditions is largely on a military footing. But this does not obviate the desirability of a further military-geological study of our mineral wealth, for conditions are ever changing and we should anticipate every eventuality. In the future, the military importance of minerals is bound

to become of increasing significance with the approaching depletion of those resources most limited in quantity.

Finally the science of geology can be made of increased effectiveness in military activites through instruction of officers and military students in the elements of military geology. This may be acomplished at no great cost of time, by means of a brief and simple course of instruction given at military schools and training camps, supplemented by a manual which may be studied in the field. A knowledge of the properties and structure of the common rocks, and of the dependence of topography upon geologic conditions, would be of repeated usefulness to the officer and add to his efficiency. Some geological knowledge, at least, he must pick up in a practical way; its systematic acquisition might advantageously be made convenient for him.

Geology as a science is keenly alive to the military service it can render. Many of its members, its state and federal organizations, and its principal societies, are actively at work on plans for geologic research and the immediate application of geologic knowledge to the public welfare. But the most effective service can not come from individual or class initiative; it must await incorporation into the general plans of governmental organization, which to be effective will omit no advantage that any department of knowledge can give.

The problem facing the geologist, at the present moment, is not so much to apply his knowledge as to lead military authorities to see clearly the service that he is prepared to render.

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SCIENTIFIC EVENTS

TUBERCULOSIS AND THE FRENCH ARMY

Dr. Herman M. Biggs of the New York State Department of Health, in the *Survey*, discusses tuberculosis in France as influenced by war conditions. According to a summary in the *Journal* of the American Medical Association he states that while practically all epidemic diseases which have heretofore been scourges of armies in the field have been brought under control in the present war, tuberculosis has assumed a large part in the sanitary history of the present struggle. France is the country that has been hard hit in this respect, though Biggs says that from such data as are obtainable Austria, Hungary, Russia, and perhaps to a less extent, Germany, have likewise suffered. As contrasted with England with 1 death from tuberculosis per thousand, New York State with 1.5, France before the war had 3 deaths per thousand, and in many cities the rate was higher. Biggs attributes this largely to the fact that even before the war France paid little systematic attention to tuberculosis. It had not been recognized by the sanitary authorities, and even now it is not a notifiable disease. With the advent of the war and the rapid mobilization of the troops, with examinations which were not sufficiently rigid, and with the strenuous conditions imposed on troops in the field, latent or arrested tuberculosis manifested itself among the troops, and by the end of December, 1915, 86,000 soldiers had been returned to their homes with active tuberculosis. In February, 1917, it was estimated that 150,000 had been returned for this cause. Biggs believes that in addition 3 or 4 per cent. of the population who formerly lived in the departments now in German occupation have the disease, which would mean another 125,000, based on a population of 4,250,000. Half of these live back of the German lines, partly in their own homes, partly in concentration camps and partly deported into Germany, many of whom have been returned on account of illness which made them a burden to their captors. Biggs says that while he was in Switzerland, of 20,000 of these people returned, 5,000 were said to have tuberculosis, though the estimated infection among those deported into Germany has been placed at 5 or 6 per cent., which Biggs believes is conservative. Among the 350,000 or 400,000 French prisoners in Germany an estimate of 5 or 6 per cent. of tuberculous infection has